

A STUDY ON TECHNOLOGIES IN CLOUD-BASED DESIGN AND MANUFACTURING

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ABSTRACT

As industry 4.0 refers to the importance and the ruling capacity of Cloud in various areas, in which the Design & Manufacturing as the most important domains in-service platform under it. Cloud computing playing an important role in data collections, synchronization, easy accessibility and also majorly on computing technology. With this support, various researchers had started implementing the same in the area of Design & Manufacturing by laying a new path in doing business by providing flexible and scalable services through internet. It creates new solutions and opportunities for modern enterprises, including the manufacturing industry. In this paper, the essential features of Cloud Computing models are discussed which helps us to understand the Cloud-Based Design & Manufacturing (CBDM).

KEYWORDS: Cloud - Based Design & Cloud -Based Manufacturing

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INTRODUCTION

The industrial revolution has brought around various supports in the manufacturing industry. While starting from the first industrial revolution how does the man started using machines which termed as mechanization, by running the machines with the use of power generated from water & steam. In continuing the same second industrial revolution started concentrating on the mass production by using the electricity based machine work, and also implementing the assembly line. Whereas in the next industrial revolution i.e., third revolution the involvement of Computers has brought change in the face of manufacturing into automation and making the availability of productivity in a short time.

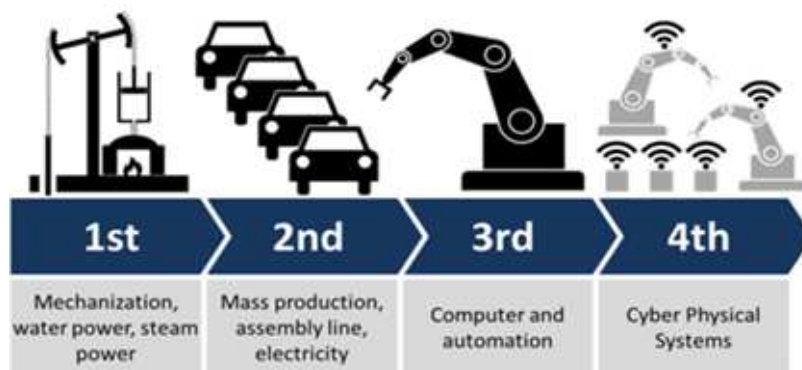


Figure 1: Transforming Phases of Industrial Revolution

The next industrial revolution has started replacing the existing traditional work with cyber-physical systems. In extending the clarity of these systems, in subdivided into the Internet of Things, Cloud Computing & Cognitive Computing. As manufacturing is dependent on Design which is even computer based, hence a study has been made on various technologies involved in cloud-based design and manufacturing. The availability of various models in cloud-based is also been discussed.

CAD SYSTEMS AND ITS MAJOR ROLES

CAD is playing on one of the major roles in understanding and one of the key features in Product Life Cycle Management. From 1960's the CAD came into the existence as numerical control based sketch control. By the end of 1960, many companies came into the commercialization of computer-based sketching, like generating 2D Drawing with a light pen using CRT monitors. From 1970's onward the conversions and single operated 2D & 3D drawings came into the existences as the advancement of computers taking place. From 1980's onward the server based computer work has come into the existence, here the server plays a minor role but client machines are much stronger. The data exchange from the server to the client has become a very risky, as there is a chance of server jam with the data. From 1990's onward the servers are playing a major role in securing the data and also the helping the other users to have limited access to data and also a server.

The CAD has been keeping on upgrading with the drastic change in the Computers, like from 2010 onwards the Virtualization, Cloud computing-based, etc., and has brought various improvements in the communications and collaborative work.

EVALUATION OF COMPUTER-BASED MANUFACTURING (CAM)

Manufacturing one of the importance of everyone's daily life, without a usage of any product the day cannot be ended. In the day to day life, we came across various things like homemaking machines, automobiles, Electronic Gadgets, etc. From 1900's onward the assembly line came into the existence which helped in reducing labor costs & increasing the rate of production. Toyota Production systems have brought change in the reduction of wastage in production, time, etc. In the 1980's & 1990's Flexible Manufacturing systems created a milestone in production systems by reducing inventory, increase in system reliability, a variety of parts, etc.

Early in the year of 2000's the manufacturing systems have started improving their sharing of information procedures, reusing the existing resources by using the web and agent-based systems. From 2010 onwards utilizing and maintaining the professional way of using Cloud-based manufacturing systems have been come into the existence which was kept on improving information sharing, resource reuse, machine utilization, etc.

EVALUATION OF CLOUD-BASED DESIGN AND MANUFACTURING

Cloud-Based Design & Manufacturing is a combination of usage of cloud in the most powerful areas in industries i.e., Design & Manufacturing. The Design and Manufacturing are interlinked and plays a key role in an industry. While stepping ahead with Automation, Cloud-based manufacturing is providing various roles on service-oriented work output.

CLOUD COMPUTING

Many industries are using cloud technologies due to the exponential growth of data to compute their activities by sharing the resources. Using deployment models a cloud can be deployed in an organization in four ways [1]. As

technology increases the risk factor in industries has also increased [2]. The cloud server is programmed to provide services to control system. This cloud-enabled control system can be deployed in four ways depicted in Figure 2.

- **Private Cloud:** By using this deployment model the services are accessible only to the members of the organization. Usually, large organizations use private cloud to automate the control system.
- **Public Cloud:** By using this deployment model the services are accessible to the general public.
- **Community Cloud:** By using this deployment model the services are accessible to a group of users from organizations. It can be managed by a group of organizations having the same platform or by the third party.
- **Hybrid Cloud:** It is a combination of two or more types of clouds.

Cloud architecture contains software, hardware, and other resources. There are four types of service models.

- **IaaS:** By using this, the user can use the resources given by the CSP. Charges are based on usage of the user. **Ex:** Amazon S3, Amazon EBS is storage services and AmazonEC2, Layered Tech is computation services.
- **PaaS:** By using this model the user can the service use given by the CSP. Charges are based on usage of the user. **Ex:** GAE, Microsoft Azure, IBM Smart Cloud, Amazon EC2 and salesforce.com
- **SaaS:** By using this consumer gets access to the software. **Ex:** Gmail, Google is the provider and we are the consumers.
- **HaaS:** By using this consumer gets access to manufacturing hardware. Manufacturing hardware includes machine tools, 3D printers etc. Using this service the consumers can use hardware based on rent from the providers. **Ex:** FUSE3 Communications.

DEFINING CLOUD-BASED DESIGN & MANUFACTURING

A model which helps in combining the cloud sourcing design by integrating the manufacturing through networking model can be term as Cloud-based design & manufacturing. Existing design model from the cloud source and by mapping the same with service-oriented architecture for manufacturing provides a clear idea of Cloud-based design and manufacturing. CBD tools examples are Invision, Notism, Solidify, Moqups, UxPin, Proto.io, Hot Gloo, and Wireframe.cc. Cloud-based networked manufacturing model includes providing on request based self-service by providing the access to the shared resources present in the distributed system to reduce the operational costs in the manufacturing process and to provide efficient task-based scheduling for optimal resource sharing in a distributed system. **Ex:** 3D Hubs. [5].

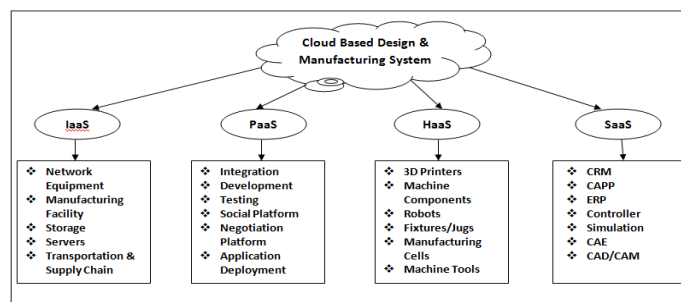


Figure 2: Cloud-Based Service Offerings in Manufacturing System

PROS OF CLOUD-BASED DESIGN & MANUFACTURING:

Web-based design and manufacturing and agent-based design and manufacturing models have been replaced with the on-time work done and reaching customer's satisfaction on the products. The major advantage is virtualization of work and multi-tenancy and its key impact on using CBDM [6].

MULTI-TENANCY

Multi means many and tenants means customers. A single instance of an application can be shared with multiple tenants and serves their requests [11]. The application will be present either inside or outside the enterprise and it will be available for the tenants or customers as shown in Figure 3.

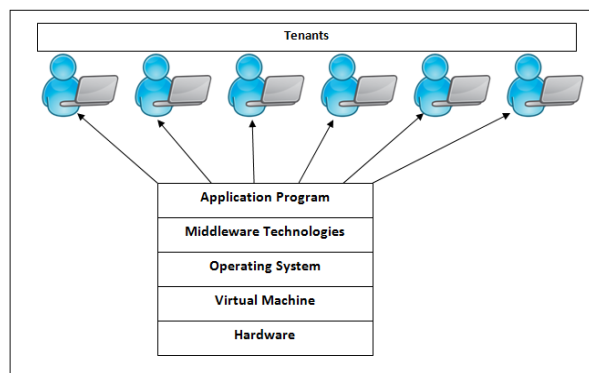


Figure 3: Multi-Tenancy in Cloud Computing Environment

VIRTUALIZATION

Virtualization is used to take part of resources or services for the dedicated hardware. A virtual version of every device can be made to create more executable environments. Using virtualization, resources can be effectively used, productivity can be increased and data loss can be prevented [3]. The different types of virtualizations are given as H/W virtualization, N/W virtualization, hard disk Virtualization, Memory Virtualization, S/W Virtualization, Data Virtualization and Desktop Virtualization [4]. The layered architecture of virtualization is as shown in Figure 4.

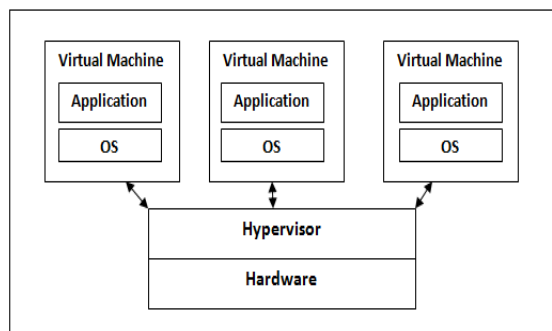


Figure 4: Virtualization in Cloud Computing

CBDM RESEARCH DIRECTIONS

Efficient cloud-based design can be achieved by using social media and current CAx applications [7]. Social media is helpful in gathering and analyzing the large amounts of social data to measure performance indicators such as customer satisfaction, flexible production, production resources and manpower, safety assurance etc. Any CAx application

such as CAD/ CAM/CAE/ Solid works, CATIA, and Uni-graphics applications can be converted into multithreading applications where multiple threads run parallel to achieve parallel computing by using event handlers, interrupts, sessions and APIs. Efficient cloud based manufacturing can be achieved by using efficient resource scheduling and resource allocation algorithms [8].

CBDM CHARACTERISTICS

Distributed File System

Using cloud, a distributed file system can be accessed by many users to perform file operations based on the permissions given to the users. Using internet technology the resources are shared with the users. Based on the usage of users billing will be done [12].

High- Performance Computing

This is used to aggregate the power of computers to act as a supercomputer to increase the speed, performance of computations. Using this complex problem can be solved in an easy way when compared with conventional desktop computers [13].

Access to Big Data

From various sources, the data is collected and stored in the form of data sets which is voluminous, huge and complex. Using cloud technology and IOT big data accessing can be done in a simple way [14].

Scalability and Agility

These two are key characteristics of cloud computing. These features are powerful, real and very important because the cloud is providing scalable and on-demand services to users. [15] and [16].

CHALLENGES IN CLOUD-BASED DESIGN AND MANUFACTURING

Research in CBDM can be taken into one of the following directions [9], [10] and [11].

- What key factors or performance indicators or measures can be used to study and analyze the networks which are generated from social media?
- Large amounts of data which is generated from the social networks can be represented as graphs. In this regards how to detect the similarities so that clusters or communities can be identified.
- Efficient resource scheduling algorithms can be developed to minimize the makespan, execution time and cost of the manufacturing process.

CONCLUSIONS

As technology starts updating the same are getting impacted on the usage of Cloud-based Design & Manufacturing in the industries especially in the domains of Design & Manufacturing. As these are two important powerful areas and playing a key role in the development of industries. While stepping ahead with Automation, Cloud-based manufacturing is providing various roles on service-oriented work output. The implementations of any new technologies will have some challenges which have to be addressed at the earliest. As the research work in analyzing the challenges and identifying the solutions for them and expecting a better approach in CBDM.

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